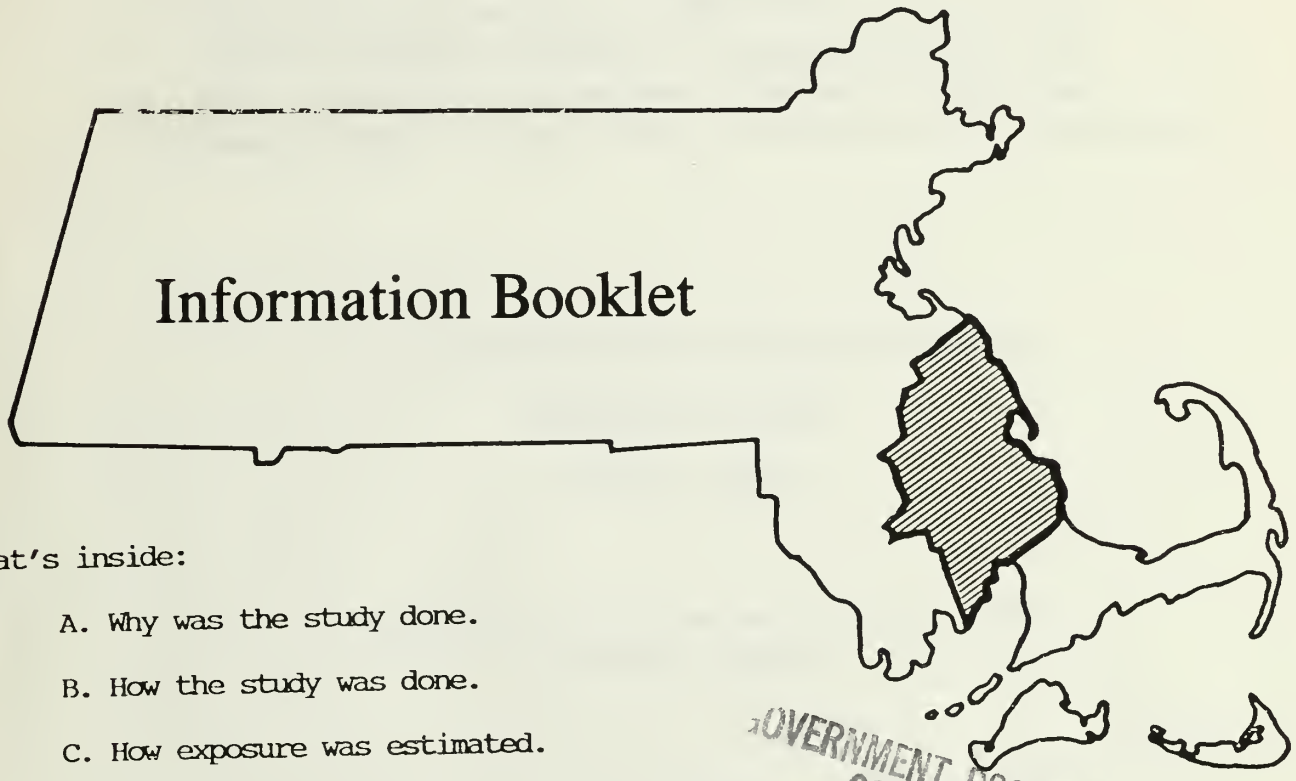
Southeastern Massachusetts Health Study Final Report



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Investigation of Leukemia Incidence In 22 Massachusetts Communities 1978 - 1986

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A. Why the study was done.

The Massachusetts Department of Public Health (DPH), Division of Environmental Health Assessment, conducted a study of leukemia among the residents of 22 southeastern Massachusetts towns with the purpose of determining the extent to which the risk of leukemia is associated with exposure to radiation from the Pilgrim nuclear power plant. The study was undertaken in response to concerns expressed by local residents, the Massachusetts legislature, and the DPH regarding excess leukemia cases observed among residents living in towns near the Pilgrim plant. Pilgrim, which began operating in 1972, had a history of emissions during the 1970s that were above currently accepted EPA guidelines as a result of a fuel rod problem. It had been alleged that these higher emissions might be related to the observed elevated leukemia incidence.

B. How the study was done.

The DPH chose a case-control study design to improve upon previous research by controlling for confounding factors, accounting for population mobility, and permitting the examination of small-area effects. Eligible cases were adults aged 13 years and older who were diagnosed between 1978 and 1986 with any type of leukemia, excluding chronic lymphocytic leukemia (chronic lymphocytic leukemia was excluded because it is the only type of leukemia not known to be associated with radiation). Cases had to be residents of a twenty-two town area at the time of their diagnosis (Bridgewater, Carver, Duxbury, East Bridgewater, Halifax, Hanover, Hanson, Kingston, Lakeville, Marion, Marshfield, Mattapoisett, Middleboro, Norwell, Pembroke, Plymouth, Plympton, Rochester, Rockland, Scituate, Wareham, Whitman). Cases were ascertained from the review of medical records at 31 hospitals serving the residents of the study area. Each case was matched to two controls. Cases and controls were administered a questionnaire by telephone, and information was collected on a subject's residential, occupational, and medical history. The responses to the questionnaires were compared between cases and controls and differences evaluated by estimating relative risk. Risk estimates were controlled for the effects of occupation, smoking status, social class, and age.

C. How exposure was estimated.

The relationship between leukemia risk and "exposure" to Pilgrim emissions was estimated by quantifying the potential for exposure, since the level of emissions received by the surrounding population was uncertain. The following criteria were used to quantify a subject's potential for exposure:

- o Proximity of an individual's home to the plant;
- o Length of residence at that address;
- o Proximity of an individual's job site to the plant;
- o Length of employment at that job location; and
- o Frequency downwind from the plant of each residence and job location.

Potential for exposure was estimated at three levels so that a dose-response effect could be measured, if present. It was assumed in the analysis that the period of time from exposure to onset of leukemia (i.e., latency period) was five years. As a result, any residence or job held during the five years prior to diagnosis was not counted in estimating an individual's exposure potential.

D. Relationship between the risk of leukemia and the Pilgrim Nuclear Power Plant.

A total of 115 leukemia cases were identified. Approximately 91 percent, or 105 cases, agreed to participate in the study. The participation rate among controls was about 66 percent.

The major findings of the study were:

- o Individuals with the highest potential for exposure to Pilgrim emissions (i.e., those who lived and/or worked the longest and closest to the plant) had almost four times the risk of leukemia as compared with those having the lowest potential for exposure (i.e., those who lived and/or worked the least amount of time and farthest from the plant);
- o An association between radiation released from the Pilgrim plant and leukemia incidence was found only among those cases diagnosed before 1984;
- o No apparent relationship with the plant was observed for cases diagnosed between 1984 and 1986; and
- o Among those cases diagnosed before 1984, a dose-response relationship was observed in that the relative risk of leukemia increased as the potential for exposure to plant emissions also increased.

After a thorough evaluation of all components of the study, the data support a finding of an association between exposure potential to Pilgrim emissions and the risk of leukemia, excluding chronic lymphocytic leukemia (chronic lymphocytic leukemia was excluded because it is the only type of leukemia not known to be associated with radiation), in adult cases diagnosed before 1984. A number of factors were examined to understand the relationship between Pilgrim emissions and leukemia risk. None of these, including occupation and smoking status, seemed to account for the elevated risks associated with exposure potential to Pilgrim. In addition, a review of other

available environmental data, such as hazardous waste sites and water supplies, did not suggest that these other environmental factors played a major role. Although it is not possible to reach definitive conclusions regarding cause and effect, the results strongly indicate that the effect of low-level radiation on the occurrence of leukemia should be further studied by other investigators to clarify the implications of these results.

E. Recommendations for follow-up action.

Based upon the results of this investigation and in order to take a prudent approach to measuring exposure to radiation from nuclear power plants the Massachusetts Department of Public Health will take the following initiatives:

1) To implement a system of real-time monitoring of radionuclide emissions so that reliable and timely information is available;
2) To develop a state air quality standard more stringent than that currently in use by federal agencies and other states;
3) In addition, the DPH will continue its surveillance of cancer in the Plymouth area through data collected by the Massachusetts Cancer Registry; and
4) Based upon the availability of resources, interviews of the families of childhood leukemia cases will be conducted, in order to gain an understanding of the risk associated with the Pilgrim plant among children.

F. Questions about the study

1. Q. Why was this case-control study done?

   A. In 1987, the Massachusetts Department of Public Health determined that the incidence of leukemia, excluding chronic lymphocytic leukemia, was significantly elevated for males and slightly elevated for females among residents of a five-town area near the Pilgrim nuclear power plant. The case-control study was initiated to explore the relationship between the plant and leukemia incidence in Southeastern Massachusetts.

2. Q. What was the risk of leukemia associated with a combination of (a) duration of residence and employment, and (b) closeness to the Pilgrim Nuclear Power Plant (i.e., the potential for exposure to Pilgrim emissions)?

   A. The findings suggested that overall the risk of leukemia was higher for those with the greatest potential for exposure to Pilgrim emissions (i.e., those who lived and/or worked the longest and closest to the plant.) The risk of leukemia was almost four times higher for these individuals as compared with those with the lowest exposure potential.

3. Q. Are people at an increased risk of leukemia from Pilgrim today?

   A. No association between leukemia risk and exposure to Pilgrim was apparent for people with the greatest potential for exposure to Pilgrim emissions diagnosed after 1983. The strength of the relationship between potential exposure to Pilgrim and leukemia was highest for individuals diagnosed between 1978 and 1983. No association between the risk of leukemia and the plant was determined for cases diagnosed after 1983.

4. Q. Which people had the highest potential for exposure?

   A. Because exposure potential to Pilgrim emissions was determined by looking at a combination of factors including place and duration of residence and employment, the study could not identify specific geographic areas where leukemia risk would be highest. However, analyses of distance to the plant suggested that the risk of leukemia was found to be more strongly associated with living ten or fewer miles from the plant than living greater than ten miles away.

5. Q. Is there anything residents should do to protect their health?

   A. DPH does not recommend any special cancer screening beyond your regularly scheduled medical checkups. No relationship was apparent between the risk of leukemia and the plant for cases diagnosed since 1984.

6. Q. What will the state do to protect health in the future?

   A. Two major initiatives will be undertaken. The first is to significantly intensify radiological monitoring efforts around the Pilgrim plant by implementing a real-time (i.e., continuous) monitoring system. The second initiative is to establish a strict air quality standard for the maximum level of radionuclide emissions, based on dose limits at the fenceline of a plant. This limit is set at 25 millirem/year by the EPA. Massachusetts proposes a standard of 10 millirem/year.

7. Q. Should residents who live near the plant move?

   A. No, while the findings are suggestive of an elevated risk of leukemia for cases diagnosed between 1978 and 1983, no elevated risk associated with the greatest potential for exposure to Pilgrim emissions was detected for cases diagnosed since 1984.

8. Q. Were people who only vacationed in Southeastern Massachusetts included in the study?

   A. The study did not consider summer residents due to the inability to identify and locate all summer residents with and without leukemia.

9. Q. Could some factor other than Pilgrim emissions explain the increased risk of leukemia?

   A. It is possible that some other factor not currently recognized, may be geographically distributed in the same manner as that predicted for radiation, however other potential exposures, such as smoking and occupational exposures, were considered and discounted.

10. Q. Is an individual's risk higher for those who live nearer the coast?

    A. The risk of leukemia in relation to the coast was examined due to concern over coastal wind patterns. However, the geographical distribution of cases did not support this concern. Individuals who lived nearer the coast did not appear to be at a higher risk of leukemia.

11. Q. Have existing monitoring efforts detected radiation off the plant property?

    A. Off-site monitoring of radiation indicated that prior to 1980, radiation levels had occasionally been detected above background (i.e., the radiation level found in other parts of the state) near the plant boundary. Off-site radiation levels have not been detected above background after 1980.

12. Q. Is there evidence of milk, drinking water, or marine life being contaminated with radiation?

    A. There has been no evidence of radiation levels above background in milk, marine life, or other biological samples.

13. Q. Have any other health outcomes been looked at around Pilgrim?

A. Yes. Infant mortality and the incidence of other forms of cancer such as thyroid cancer, have been examined. Infant mortality shows somewhat higher rates during the mid-1970s, however, the number of deaths is small. Other forms of cancer take a greater number of years to develop than leukemia. As additional data is collected by the Massachusetts Cancer Registry, these other cancers will by followed to determining if their incidence is higher than expected.

14. Q. Was the study methodology and results reviewed by experts from outside the DPH?

A. Yes. Four epidemiologists experienced in conducting leukemia research and the relationship between leukemia and radiation reviewed the study design and results.

15. Q. How does this study compare with other studies around other nuclear facilities?

A. Very few studies of the type conducted have been carried out. Most of the recent studies of cancer incidence around nuclear installations have been descriptive in nature and did not interview cases and controls to obtain detailed information on residence and confounding factors.

The recent survey conducted by the National Cancer Institute (NCI) was an investigation only of cancer mortality and only examined mortality rates on the county level. However, the DPH had previously conducted a similar study looking at cancer incidence and reported that leukemia incidence was higher in towns near the Pilgrim plant as compared to the state as a whole.

The current DPH investigation is an attempt to follow-up the earlier report in order to determine if the Pilgrim plant may have caused the observed elevated leukemia incidence. This DPH study attempted to improve on the study design used in most other studies and, thereby, was better able to detect increased risk estimates related to the specific environmental exposure of interest.

16. Q. Have Pilgrim emissions ever exceeded Federal government regulatory limits?

A. The Nuclear Regulatory Commission (NRC) regulatory limit has been in place for the entire history of the Pilgrim plant. On an annual basis this limit of 500 millirem has never been exceeded by Pilgrim. The existing EPA limit is set at 25 millirem/year. This limit was established in 1980. The EPA limit has not been exceeded since its development. If this limit had been in effect during the earlier operating history of Pilgrim the plant would have exceeded this limit in the mid 1970s.

G. Where to get more information

A copy of the report has been provided to the main library of each of the twenty-two towns in the study. A toll-free number can be called until October 31, 1990 for answers to additional questions. That number is 1-800-535-3937. After October 31st, the Division of Environmental Health Assessment of the Massachusetts Health Department can be contacted at (617) 727-7170.